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16 MAY 1980

SIMULATION IN TRAINING--THE CURRENT IMPERATIVE

by

Lieutenant Colonel Richard P. Diehl
Infantry

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USAWC MILITARY STUDIES PROGRAM PAPER

SIMULATION IN TRAINING--THE CURRENT IMPERATIVE

INDIVIDUAL STUDY PROJECT

by

Lieutenant Colonel Richard P. Diehl
Infantry

US Army War College
Carlisle Barracks, Pennsylvania 17013
16 May 1980

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PREFACE

This individual study project was undertaken to produce an article for publication in a research, development, and acquisition-related journal. It is designed to portray the Army's training system, the urgent need for training support systems, the inadequacies in the current training device development and support system, and to advance possible solutions to noted problems.

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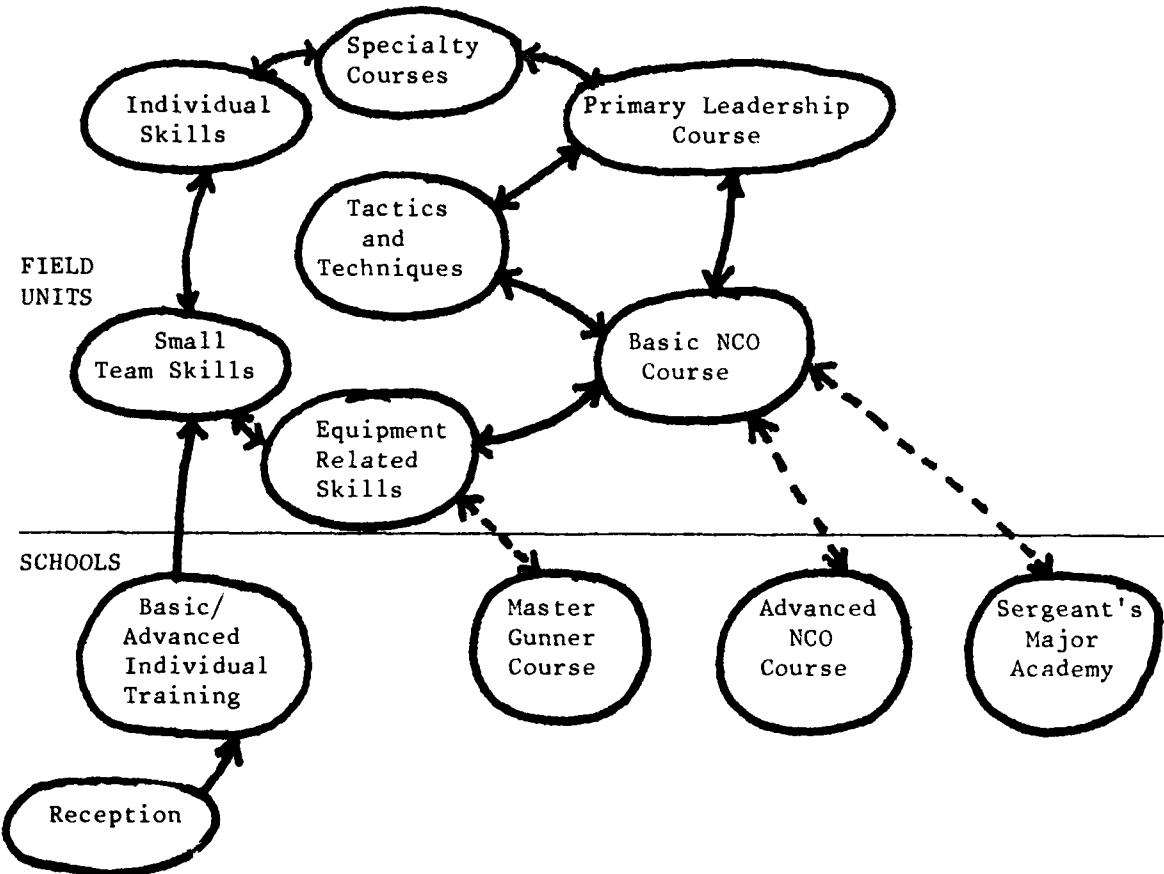
SIMULATION IN TRAINING--THE CURRENT IMPERATIVE

The US Army can no longer afford to train its forces as it has in the past. Equipment and petroleum products are becoming inordinately expensive. Today's munitions (and Laser Range Finders)--in addition to being costly--have such extended ranges that many of the range complexes that have been sufficient in past years are no longer adequate--and there is no room to expand them. Mechanization and the fluid tactics it allows has extended the breadth of tactical operations such that training areas that once were big enough for large field maneuvers are now confining at best.

Our European allies have been faced with similar problems for decades. Their limited military budgets have not permitted them to have a "steel on target" philosophy of training. Further, their civilian populace has demanded that scarce land be devoted to production rather than military readiness. The Europeans have long embraced simulation as an alternative. As a result, European industries are ahead of their US counterparts in developmental research and marketable training support products. Furthermore, unless there are changes in the way the US Army develops simulators, that comparative advantage will remain.

Before we consider the shortcomings in the current US system for developing training simulators, (the terms simulators and devices will be used interchangeably herein) we must understand that training system which they are designed to support. This is important also in that Department of the Army Pamphlet 310-12, the catalog of Army training devices, is full of simulators that have been developed in the past. This would appear to be a contradiction; yet, as the reader will soon see, it is not.

The US Army--and for that matter the armies of our allies--has a training system that essentially follows the pattern below.

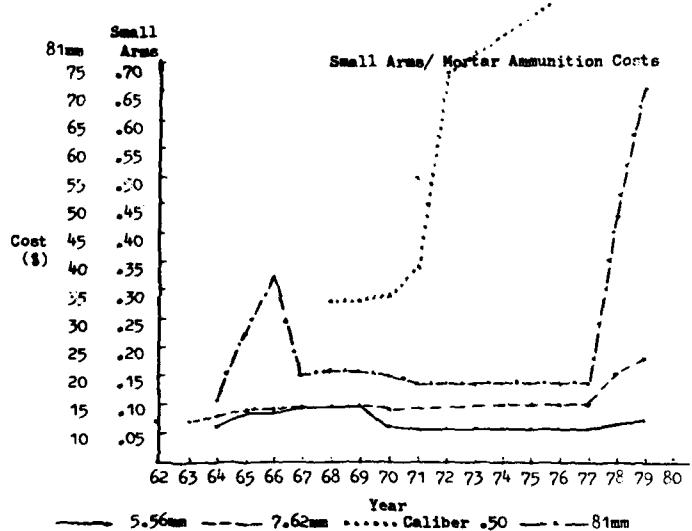


Note as the individual enters the Army he is sent to a branch-related school for basic and advanced individual training. The length of time spent in school varies with specialty, but for those specialties of interest herein--Maneuver and Fire Support, i.e., armor, infantry, and artillery--that time is twelve weeks. This preliminary training teaches the individual basic soldier skills, weapons firing, and about 10% of the critical skills he needs to perform his combat job at a basic skill level. From the school he is assigned to a field unit. That is the location where the preponderance of his training actually takes place. Should the soldier stay in the Army, he may later return to the

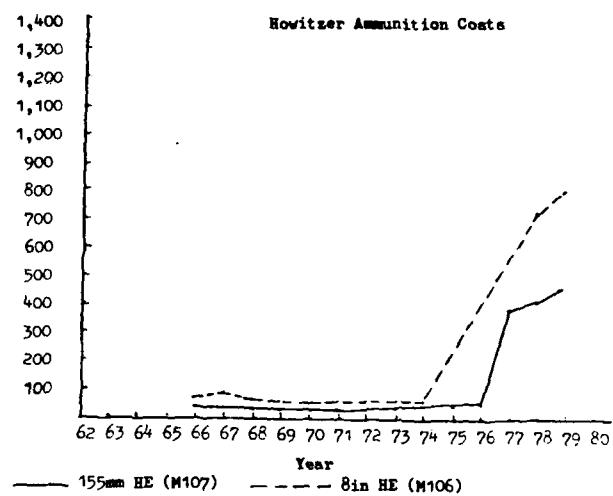
school system for brief professional development courses but those occur after many years spent in field units learning the rudiments of his vocation.

There is a dichotomy in the way simulators have traditionally fit into this training system--most training occurs in the field but the preponderance of the simulators in the inventory are for school use. The reason for this is schools have been subject to severe budgetary constraints, personnel restrictions, intense scrutiny of "student/instructor" ratios, and limitations on the amount of actual equipment available for training. In addition, because of the functional consolidation that occurred with the formation of the Training and Doctrine Command in 1973, schools have been assigned numerous non-instruction responsibilities--training extension courses, training device requirements development, user representation, field manual development, combat developments, correspondence courses, --that draw resources away from platform instruction. In that environment simulation has been valuable; generally, those are the simulators to be found in DA Pamphlet 310-12.

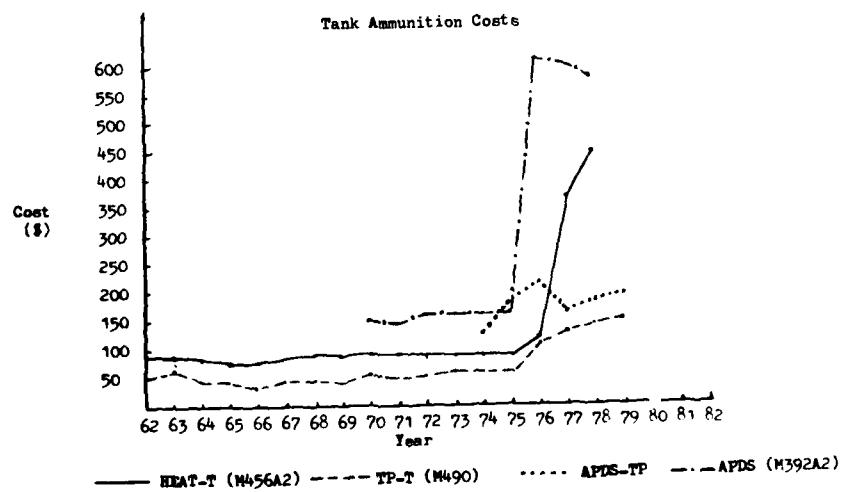
In the field, the thinking has traditionally been: "We have the equipment; why not use that equipment to train?" That has been reasonable given there has been sufficient ammunition and fuel, enough operating funds to pay for the repair parts required as the equipment broke in use, and enough space to employ the equipment as it would be in combat. A cursory look at Graphs 1 through 9 shows that the way training has always been conducted in the field is no longer affordable at today's prices.



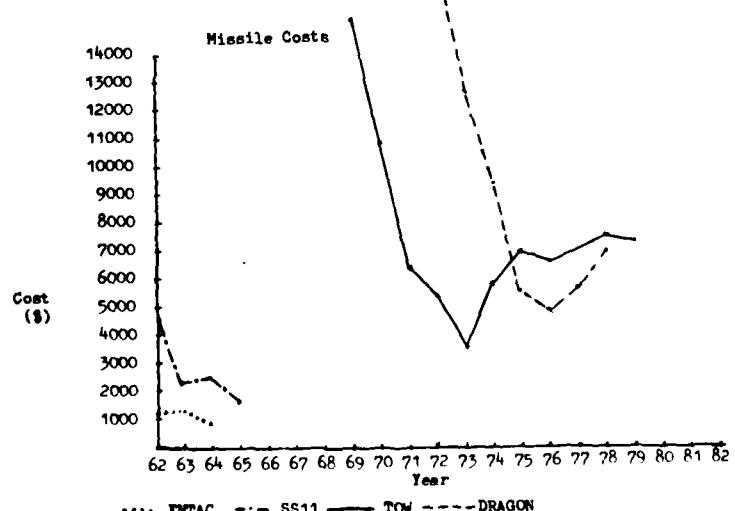
Graph 1



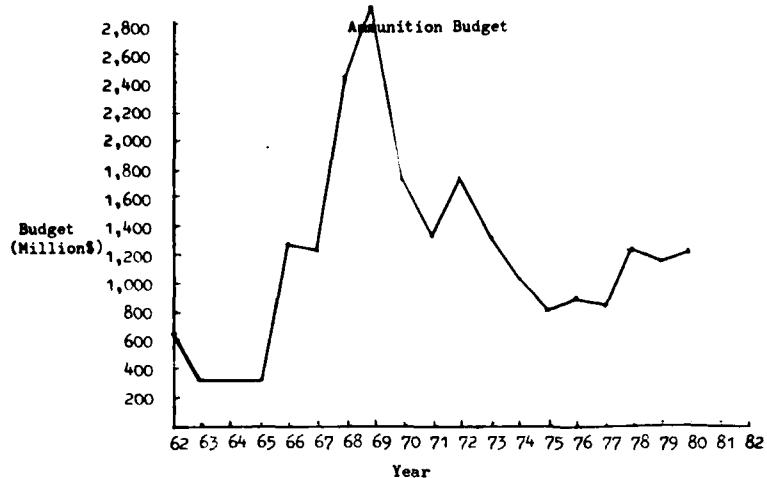
Graph 2



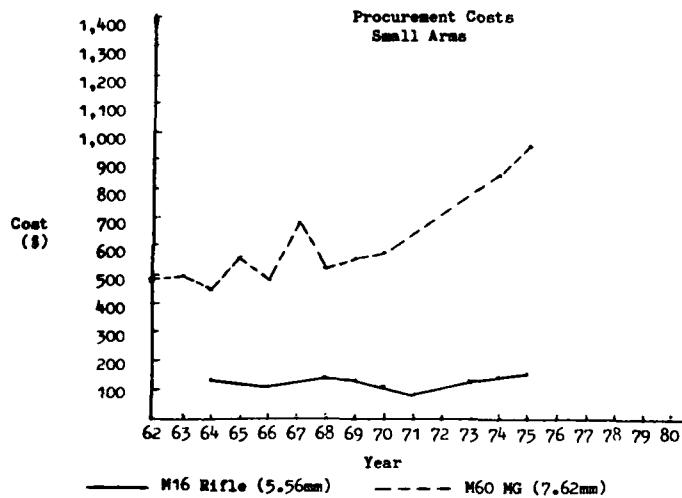
Graph 3



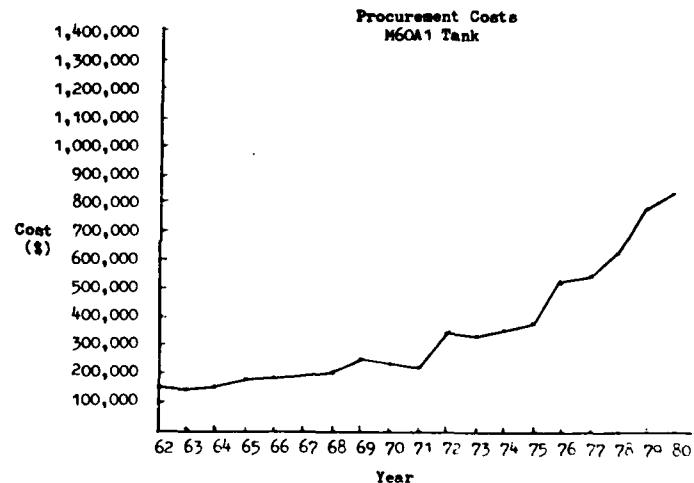
Graph 4



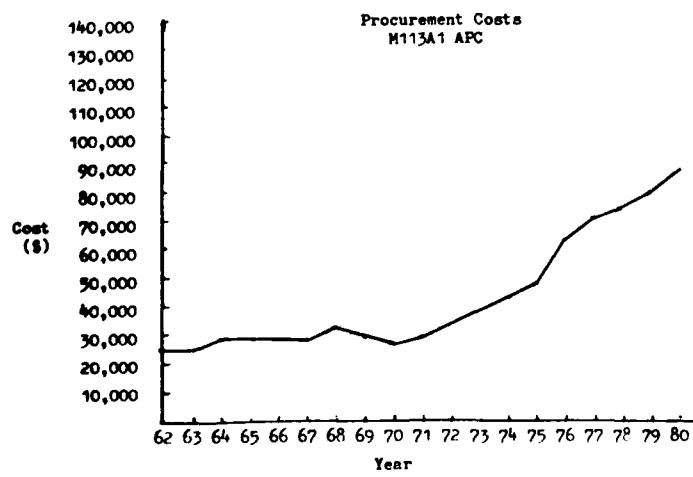
Graph 5



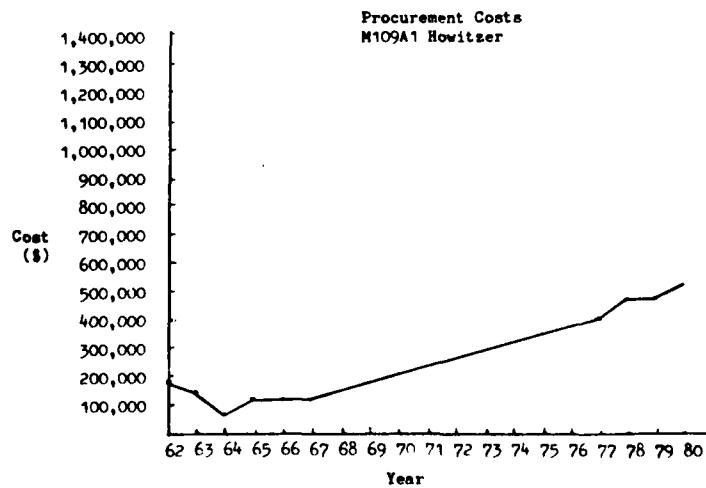
Graph 6



Graph 7



Graph 8



Graph 9

Graphs 1 through 4 highlight the extensive cost growth that has occurred in various categories of ammunition; some are quite startling. Yet Graph 5 shows the trend in the ammunition budget. Note: the Fiscal Year 1980 budget is about equal in absolute magnitude to that of 1965. However, these are not expressed in constant dollars! Inflation makes the real value of the 1980 budget significantly lower than that of 1965. Further, the amount shown for fiscal year 1980 was the original budget projection--the administration's efforts to balance the Federal budget resulted in a decrement of \$50 million, the preponderance of which occurred in training ammunition. Thus, one can readily discern the cost/budget pinch confronting field trainers.

Graphs 6 through 9 show the cost growth in various equipment classes. In the decade of the seventies, the M60A1 tank increased in price by over 325%--the M113A1 armored personnel carrier by almost 320%, and the M109A1 howitzer by over 460%. As new systems emerge, the prices go up drastically; the procurement costs of the XM1 tank (\$1.1 million) and XM2/3 fighting vehicles (\$600,000) illustrate this. These cost escalations make a field training strategy which relies on major items of equipment questionable today and in the future.

The cost problem extends to repair parts as well. Table 1 shows the current costs of various components that are habitually broken in field training.

Component	System		
	M60A1	M113A1	M109A1
Engine	\$56,576	\$9,041	\$11,750.00
Transfer	2,688	1,440	-
Final Drive	3,611	986	2,000.00
Transmission	30,349	3,165	28,000.00
Differential	-	3,960	-

TABLE 1*

*Data provided by DARCOM Commodity Managers

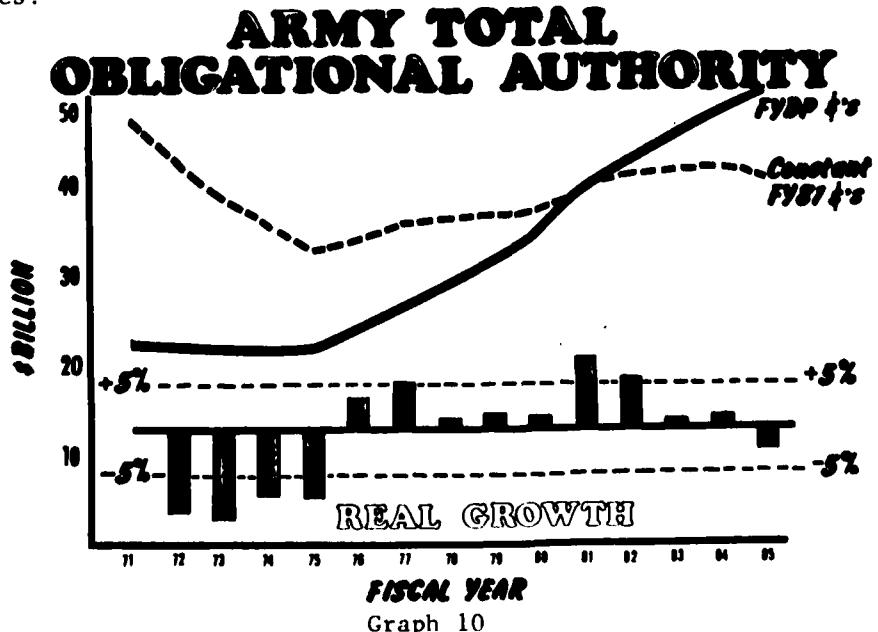
The total cost for replacement items like these Army-wide is over \$11 million yearly. That figure represents not only normal malfunction but also the effect of soldier breakage through mishandling as he learns about the equipment through "hands-on, trial and error." The percentage of breakage in the latter category varies by equipment component, local conditions, and other factors--and it is not known for certain--but it may approach 20-25% Army-wide.

The soaring costs of fuel and other petroleum products are evident to everyone. That has an immense impact on training in the field. Table 2 shows the current operating costs per hour for a tank, armored personnel carrier and howitzer.

Vehicle	Operating Cost/hour
M60A1	\$1074
M113A1	264
M109A1	1944

TABLE 2

Though the force has experienced the depicted severe cost growth, the Army's budget has not kept pace. Graph 10 shows the budget history of the seventies.



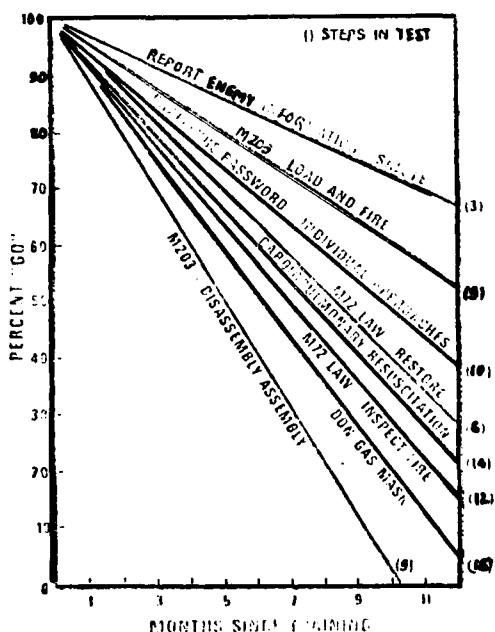
Note in real terms the Army in the face of rising costs has actually lost budgetary buying power over the decade.

There are certain indirect costs as well that inhibit field training. There is only limited space on which to do the training and that limited space must be shared by a great number of units. That is particularly acute in Europe and will become more so when the weapon systems currently in development are fielded. As an example, there will be but one training area (Grafenwoehr) at which the XM1 tank will be able to be fired. In the United States the situation is not quite that confining; however, the added range safety requirements of the XM1 will require safety waivers almost everywhere (with attendant stringent, restrictive rules attached). As an example, Fort Hood, the Army's largest tank-force post, will have sufficient space for but one qualification range for the XM1, while today there are three for the M60 series tanks. That situation will be even worse later when the longer range 120mm smooth bore gun is incorporated into the XM1 tank system.

One of the programs that the Army has started, to counter range problems, is the newly formed National Training Center. This vast facility will be housed in the desert at Fort Irwin, California, where all current and future weapons can be accommodated range-wise. Projected by 1984 will be a facility that can accommodate up to 42 heavy battalions--maneuver and fire support--per year. At this facility will be the latest in training technology--to include the Multiple Integrated Laser Engagement System, a position locating system, and changeable target arrays. Units will arrive at the facility, draw equipment on-site, and train extensively for about two weeks. The British and Germans, for their live-firing segment of training, have adopted a similar strategy--at Suffield and Shilo, Canada, respectively--in which units in Europe are moved similarly onto equipment for intensive, live-fire, field

training. This does not solve the cost problems described earlier; in fact, it adds an additional cost factor--transportation to and from the facility. More importantly, perhaps the most significant detractor is a battalion will only be able to undergo training at the facility every eighteen months--and the US units in Europe will not be scheduled to use the facility. Given the typical rates of learning decay the soldier experiences (Graph 11) and particularly the crew/squad personnel turbulence that is a fact in the US Army (Graph 12), it seems a different and perhaps complementary approach is needed.

LEARNING DECAY

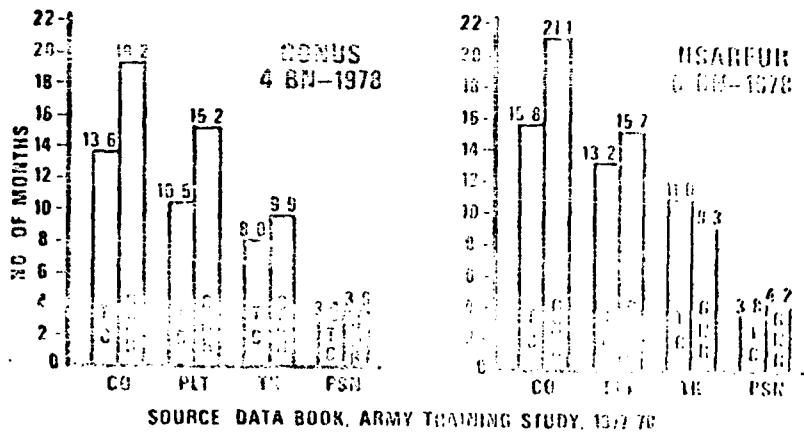


SOURCE: ARMY BASIC SKILLS REFERENCE STUDY, 10 OCT 74

Graph 11*

*Data Provided by the Director, Training Device Directorate, Army Training Support Center.

TANK CREW TURBULENCE



Graph 12*

*Data Provided by the Director, Training Device Directorate, Army Training Support Center.

There must be support systems developed that will allow field units to train individuals, crews, and tactical units at home stations--field units need simulative devices desperately. Yet there are hurdles in the research, development, and acquisition processes that complicate, retard, or totally preclude the adoption of a simulation-based training strategy. Generically, these hurdles could be described as: (1) timeliness of simulator developments, (2) management diversity, (3) funding dilemmas, and (4) logistical support system inadequacies.

TIMELINESS OF SIMULATOR DEVELOPMENTS

It takes too long to develop and field simulators today. Within the Army's Catalog of Approved Requirements Documents there are active training device requirements that were approved for development and procurement as far back as 1972--most of these systems still have not been fielded. One may counter that some of these systems are complex, perhaps state-of-the-art, developments that require long development cycles. Yet, some of these items

were, and are, available on the commercial market either from domestic or foreign sources. What causes these delays? They vary. The user may want added features not available on the commercial models--they may be "nice to have" features, "gold plating" or indeed legitimate critical features necessary to support the training objectives. Army commodity commands or laboratories may hypothesize they can build a better piece of equipment. Sufficient funds may not have been approved to finance the program. The commercial firms may be small businesses that may not be fully reliable financially or production-wise. There are myriad other reasons each of which puts additional time into the equation.

However, the US Army cannot accept these various delays and comply with Department of Defense directives and/or Army regulations which require that any system to be fielded must have its total support system, to include the training support system, functional when the weapon system is introduced to the field. For the systems already in the field, the user cannot afford to wait the 7-12 years needed to traverse a normal full hardware development cycle if he has a critical training need today.

The problem of developing training support materials for weapons systems in development is the hardware characteristics of the support materials are not finalized until the tasks necessary to be trained--termed front-end analysis--have been determined and tested. That testing ideally concludes during the weapon system's developmental/operational test II; it may, as it has been in some systems, be even later than that. That means to have a fieldable training simulator by the time the weapon system begins introduction to the field, that simulator must follow a research, development, and acquisition cycle that fits time-wise into the facilitization, low-rate initial production, and production cycles, perhaps 2-3 years.

For fielded systems, the task analysis of the training support requirement may not be--and probably never is--as rigorous as that for a developing weapon system. Rather the field requirement is generated by other factors such as cost growth or no time or land on which to train. Thus, the need is immediate and driven by resource constraints.

The reasons compression of the research, development, and acquisition cycle has heretofore been unsuccessful are many but generally they revolve around requirement staffing delays, a penchant for low-risk development approaches, over-testing, and excessive reliability, availability and maintainability (RAM) requirements. Shown in Table 3 is the sequence and associated time required for the DARCOM and TRADOC communities to staff, complete, obtain approval for, and publish a requirements document of some type--training device requirement, letter requirement, or training device letter of agreement.

Until that document is complete (and approved at the appropriate level) no monies can be applied to the developmental and/or acquisition effort. Note the number of participants in the process. Not stated in Table 3 are the extensive tangential requirements that must accompany the document if it requires Department of the Army approval. In that case, to obtain approval a Basis of Issue Plan (BOIP), Quantitative, Qualitative, Personnel Requirements Inventory (QQPRI), and a preliminary Cost and Training Effectiveness Analysis (CTEA) must be completed and accompany the basic requirements document. That adds to the bureaucratic burden and inherent time delay.

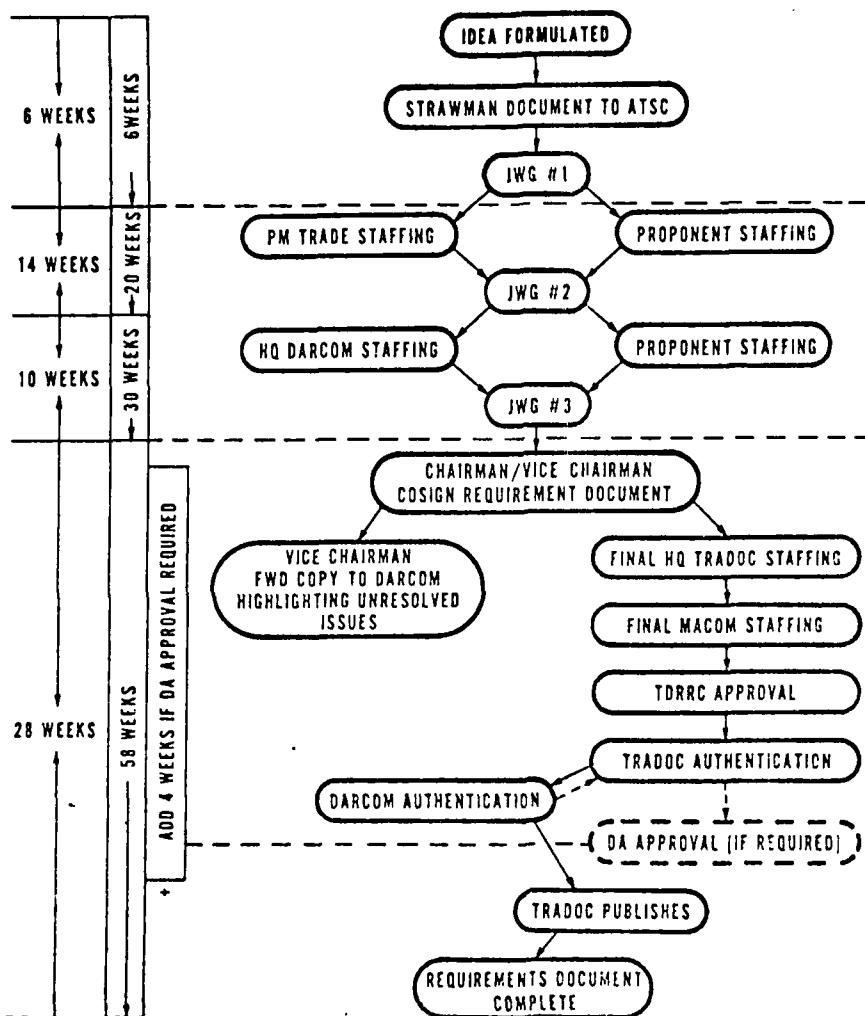


TABLE 3*

*Provided by Project Manager, Training Devices.

One can readily see a direct parallel to the requirements generation process for a major weapons system. Indeed, research, development, and acquisition (RD&A) of training devices are governed by the same series of Army regulations. However, how can the training device RD&A cycle be compressed into a two to three year period when it habitually takes 58 weeks just to obtain approval for the requirements document? It obviously cannot, even if the item is commercially available, given contracting/source selection leadtimes, testing requirements (even if limited), technical documentation, and logistical system startup.

In developing a major weapon system, managers attempt to minimize risk. That is done in a number of ways but the formal method is to replicate test sampling sufficiently to develop very high confidence that the system will do what it was designed to do. That same theme carries over to the development of training devices. The training device is looked at as another piece of hardware that must undergo the same developmental/operational testing cycle as a major item of equipment. There are significant differences. The training device does not have to withstand the rigors of combat; thus, hardware testing replications and statistical confidence levels can be reduced. Further, the importance of the testing should be to determine if the device actually supports the training objectives and allows the soldier(s) to attain the standards desired, i.e., effectiveness of transfer of training. RAM testing remains important but for a different reason--if the device constantly breaks in use, personnel in field units will lose confidence in it.

How can these problems be solved? The staffing requirements can be decreased by reducing the number of direct participants and by decentralizing training device requirement (TDR) approval authority to the TRADOC/DARCOM level as the letter of agreement (LOA) and letter requirement (LR) systems

have done. Like the LOA and LR, Department of the Army could retain approval authority for device RD&A programs over certain high-dollar thresholds-- however, decentralization is needed. For the system-related devices, this is simple to implement--the Required Operational Capability (ROC) of the weapon system should give authority to develop training devices as appropriate. Any documentation beyond that should be used to formalize specific device hardware characteristics and required training criteria. For devices developed for systems already in the field, a similar lessening of written exhaustiveness is needed.

To further reduce the staffing time required, the number of participants should be limited. The importance of the requirements document is to state what the device must do vis-a-vis the training function, hoped for hardware characteristics, if known, where and how the device will be used, and what type of logistical support the user prefers. With that information, the materiel developer can proceed. Basis of issue plans, personnel impact, integrated logistical support, acceptable RAM risks, commodity manager handoff plans, detailed cost/budget estimates are important but they can proceed in parallel and need not slow down the request for proposal/contracting actions of the materiel developer. Yes, there is some risk associated with this accelerated RD&A cycle--but to compress time, as the cycle must, calculated risk must be taken. Army Regulation 71-7, the Army's training device regulation, must be tailored around expediting and exception to the "normal" RD&A themes-- that is not the case now.

RAM criteria--though they vary with each device--must be tailored to the training criteria stated by the user. For instance, if a device is to be used statically in the breech of a gun, there is no reason to subject it to 40-foot drop tests. RAM and the associated testing of RAM features, should be

approached differently than in weapon system/hardware development. Testing should be to determine what the RAM characteristics of the tested item are rather than to determine whether predetermined RAM criteria are met. That testing should be secondary to that which should determine whether the device does what the trainer/user wants. The acceptability of the demonstrated RAM characteristics then should be the joint decision of the customer--the field trainer or his TRADOC representative who knows the environment in which the hardware will be used--and the commodity manager who will be responsible for the actual logistical support whether it be contractor-supported or otherwise. Note the materiel developer was not included--he should react to the decision. Further, the Logistics Evaluation Agency--now by regulation the voting representative of the "logistician" at decision reviews--was not included. Though that agency is important for independent assessments, it has no stake in actual implementation.

MANAGEMENT DIVERSITY

The management structure for the development of training devices needs modification. As mentioned earlier, there are too many participants in the current system. As brief background, in 1972 the Chief of Staff of the Army, partly as a result of recommendations of the Board for Dynamic Training, ordered the establishment of a group--known as the Combat Arms Training Board--to stimulate and improve training Army-wide. That group was given a very broad and powerful charter and substantial funding to allow it to function "outside of the system." Part of the group's effort was devoted to the development and acquisition of training devices. Members of the group wrote training device requirements, staffed them directly with the field, schools, materiel developers, and logisticians, and expedited, through Department of

the Army staff officers, the central approval process. Requirements generation and staffing were accomplished very rapidly. However, to "systematize" the process, it was recommended to the Commander, Training and Doctrine Command (TRADOC) that a project manager for training devices be established in the DARCOM (then USAMC) community and that a similar TRADOC organization be established and be co-located with the project manager to expedite device development efforts. In concert with the Commander, DARCOM this was implemented. A Secretary of the Army-chartered project manager for training devices (PM TRADE) and a similarly manned TRADOC Training Device Requirements Office (TRADER) were established in 1974 and were co-located at Fort Benning, Georgia. The Army Training Device Agency (ATDA), the agency previously responsible for development and logistical support of training devices was made subordinate to the project manager. That agency was co-located with the Navy Training Equipment Center in Orlando, Florida.

PM TRADE was not chartered to develop all training devices; those devices to support project-managed weapon systems remained within the purview of the system project manager. However, PM TRADE was to be available for consultation and could be employed to develop the devices if the system manager so chose. TRADER was the direct TRADOC representative for all project managers. In 1976, organizational consolidations led to the physical separation of PM TRADE and TRADER. PM TRADE consolidated with ATDA in Orlando and TRADER became a directorate subordinate to the newly formed Army Training Support Center (ATSC) at Fort Eustis.

That action weakened the management system. As a subordinate of the ATSC, after having been directly subordinate to the TRADOC Deputy Chief of Staff for Training, the training device directorate lost its directive charter vis-a-vis relations with TRADOC schools. Though the agency kept the responsibility for

being the user representative and TRADOC focal point for training device development, the schools were saddled with the major responsibility of requirements generation and staffing. Coupled with the schools' already burgeoning, diverse responsibilities as well as reduced manning priorities for the training device directorate (by summer 1980 that office will be manned with 15--mainly civilians--of its 31 authorization), the TRADOC portion of the requirements generation process bogged down. At the same time the staffing process, as mentioned above, became more expansive. The result was programs slipped for lack of approved requirements documents, the budgeted funds were diverted for they could not be obligated without an approved document, and RD&A programs were postponed.

Needed is a TRADOC agency with a directive charter similar to that of a DARCOM project manager. The charter must be based upon the central theme of expediting the development of training devices. That agency cannot be a part of a staff and be effective--it must be an operating agency. This approach is not far different from the concept of the TRADOC system manager. However, this agency cannot be so lightly manned. Members of the agency should be predominantly military officers who can work directly with experts in the schools to structure requirements, do the staffing "legwork," and free those in the schools from technical or bureaucratic trivia. The agency must have the authority to represent fully the user community.

FUNDING DILEMMAS

For years, training device funding was minimal. With the establishment of the PM TRADE office, and a coincident recognition by those who were at the highest levels of the Army hierarchy at the time that simulation offered significant dividends in the face of escalating costs, substantial funds were

programmed to support non-system training device RD&A. However, funds programmed and those actually obligated have recently been significantly different.

Table 4 illustrates this quite vividly.

FY 1980 Research and Development Funding Projections*

Type Funds	Percent Available for Device Obligation	Percent Retained at DARCOM or DA Level	Percent Lost on Program Termination	Percent for Internal PM Operations
Concept (6.2)	89%	11%		
Validation (6.3)	17.7%	42.4%	39%	
Engineer Div (6.4)	61%	20%		19%

*Percentage rather than actual figures are used herein because of the sensitivity of funding levels

TABLE 4

In terms of total dollars, PM TRADE has but 46% of the programmed monies available to support non-system training device research and development. Forty-six percent of those monies were diverted for other purposes. The rest is to pay project manager employees. The Administration's efforts to balance the budget has led recently to substantial cuts in FY 1982 and 1983 programmed monies. Also recent programming changes require each "new start" training device program to compete with major programs for funds; thus, this has put the future of training device developments in grave jeopardy.

There has been a considerable amount of Other Procurement Army funds released to PM TRADE in fiscal 1980 (97% released, 3% retained by DARCOM); however, 97% of the funds available were devoted to the purchase of some of the components of the Multiple Integrated Laser Engagement System. The remaining monies represent purchases within but two minor training device programs.

The fact that funds have been released to PM TRADE does not mean they will be obligated as planned. As mentioned earlier, if an approved requirements document is not available, the funds cannot legally be obligated. If the contracting process--which habitually takes six to nine months--cannot be completed before the last quarter of the fiscal year, there is a good likelihood DARCOM will reprogram the funds to other programs with a resultant delay in contract award until the next fiscal year. Obviously, that will require reprogramming either internally at PM TRADE or within DARCOM to restore all or part of the funds lost.

Another problem facing PM TRADE is the advantage small business firms enjoy in competitive programs. Given the normally low dollar program levels, small businesses often use their procurement regulation competitive advantage to obtain contracts which are beyond their capabilities. In addition, the "Buy American" provisions of the procurement regulations often put higher-technology European firms at a competitive disadvantage. System project managers budget and program monies to support the development of system training devices even though they may have PM TRADE conduct the RD&A effort. The problem that has traditionally plagued these programs is there is a tendency to divert training device funds to the weapon system proper when additional monies are necessary. The result: system device RD&A programs either slip to program years, are reduced in scope below original user-stated requirements or are cancelled.

What is the solution to this dilemma? Should the various-level reprogramming authority be withdrawn? No! That authority, even if it could feasibly be altered, is necessary for overall management latitude. What is necessary is a changed state of mind in the training and materiel development communities to recognize a piece of weapon system hardware either being fielded or already

in the field is not enough; there must also be at the same time a system available to train the field soldier to use it effectively. Department of Defense directives and DA implementing regulations give clear direction--the system will not be fielded without a total support package. Required is enforcement of the directives.

LOGISTICAL SUPPORT SYSTEM INADEQUACIES

Logistical support of training devices has essentially remained outside the commodity manager system. PM TRADE inherited that mission when the Army Training Device Agency was subordinated to it. The system essentially worked at the user level either through the post Training Aids Support Office (TASO) or direct to PM TRADE for direct or general support maintenance or replacement. Depot support was provided centrally by the Tobyhanna Army Depot.

Recently the Commander, DARCOM ordered that system changed to free PM TRADE from this logistical burden. He ordered the appropriate commodity managers to assume the responsibility. There are likely to be great problems with this decision. The preponderance of the training devices in the system are non-type classified since they are low density items. In the past, central DS/GS management of these devices was effective in that most have no technical data package and the facilities at the Naval Training Equipment Center have, in many cases, fabricated parts for them. Additionally, personnel involved, both at the depot and in the ATDA-derived apparatus, are experienced in making this "non-standard" operation work. In addition to the cost of adding these devices to the commodity system, these "exceptions" may be extremely demanding on the commodity commands.

The weak link in the logistical system is the TASO. It provides direct user interface and represents the only organizational level maintenance activity.

However, these offices--a single facility in USAREUR and numerous FORSCOM-controlled facilities in CONUS--are ill-equipped and poorly manned to provide other than rudimentary organizational services. To impose organization maintenance of training devices on unit personnel has always been an unacceptable solution--rightfully so. Thus, what devices have been available at unit level have generally been contractor-supported through the PM TRADE system. This system is inappropriate for high-density devices designed for field unit usage. An example of the cognition of this weakness was the decision of the Commander, TRADOC to suspend Fiscal Year 1981 purchases of potentially-invaluable Multiple Integrated Laser Engagement System components because of the lack of an adequate logistical system to support these items Army-wide.

It seems the only feasible solution to the logistical support problem for high-density training devices is the commodity command system--at the unit level these items should be turned over to post-level maintenance facilities on an exchange basis. From there repairs can be done either by contractor support or with the post assets. Europe and Korea have different problems. Contractor support may work in some cases--however, GS-level maintenance facilities may be required to support certain high-density items like the Multiple Integrated Laser Engagement System. Non-type classified, low-density items perhaps should better continue to be centrally managed--Tobyhanna Army Depot seems the best solution.

CONCLUSIONS

Contained herein have been several ideas about the training needs of the Army in the field. The discussion has been general rather than highly detailed. It is a fact the Army is facing severe cost growth in every area that relates to field-level training. The Army budget has not kept pace nor will it in the

future. Units in the field are confronted with a training dilemma--they can no longer afford to train as they have in the past and with the introduction of new, more costly and longer-range weapon systems, the situation gets worse. Yet they cannot achieve the maximum effectiveness of their sophisticated weapons systems unless they can train the soldier element of the system. Simulation provides an affordable solution to this dilemma but the development community cannot now provide the simulators needed in a timely manner. What must be done? First, the US Army must recognize the cost problem facing field units--that is happening now. Secondly, the Army must get serious about simulation. Sufficient monies must be provided and must be left in the programs. The management structure must be streamlined and a logistical system that will be effective, yet not a burden to field units, must be developed. The solutions advanced herein are not the only ones; they are the opinion of the author. The point is the Army must solve the generic problems cited quickly. The effectiveness of the force depends upon that solution.

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